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AUTHOR	McCallum, W. F.; Botly, D. H.
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ABSTRACT

These activities are part of a series of 17 teacher-developed instructional activities for geography at the secondary-grade level described in SO 009 140. In the activities students develop map skills by learning about and using nautical charts. The first activity involves students in using parallel rulers and a compass rose to find their bearings. Their ship, Prince Edward, lies in an anchorage. They must take a bearing of eight other ships and record these bearings in the deck log. In the second activity students use dividers and the latitude scale to measure distance. During the class project they lay out courses to steer and distances to run to bring their ship from one designated position to another. In the third activity students learn to interpret the common symbols found on a nautical chart by responding to discussion questions. Activity four is a simulation exercise in which students apply the skills learned and the knowledge gained in the first three exercises by using a nautical chart to move their ship from Passage Island to Thunder Bay. Brief explanations, diagrams, maps, symbol definitions, and a glossary of terms are provided. (Author/DB)

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INSTRUCTIONAL ACTIVITIES SERIES IA/S-11

NAUTICAL CHARTS: ANOTHER DIMENSION IN DEVELOPING MAP SKILLS

by

W.F. McCallum and D.H. Botly
Associate Professors, Faculty of Education, Lakehead University
Thunder Bay, Ontario

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A new and added dimension to the development of map skills can be provided by the use of nautical charts in the geography classroom. The authors provide a sample of activities that might be used to help students understand the use of nautical charts and to further the development of selected map skills. Each of the following activities will aid students in achieving competency in a skill or concept identified in the performance objectives that accompany each activity.

Activity #1 - Using the parallel rulers and compass rose to find bearings.

Activity #2 - Using dividers and the latitude scale to measure distance.

Activity #3 - Interpreting the common symbols found on a nautical chart.

Activity #4 - Chartwork activities.

The fourth session will have the students apply the skills and knowledge in a simulation activity using an actual nautical chart.

SP 009 160

Activity #1 USING PARALLEL RULERS TO LAY OFF BEARINGS

Objectives:

Upon completion of this activity the student will be able to:

1. express as a true bearing the direction from one point to another on a nautical chart using parallel rulers and the compass rose.

2. use parallel rulers with enough dexterity to measure within 2^{o} the actual bearing between two locations identified on a map.
3. explain each of the following terms and their significance in taking bearings on a map;

bearing, compass rose, parallel rulers.

BEARINGS

A bearing is nothing more than a direction from one point to another and is indicated by a number of degrees from 000^{o} (due North) to 359^{o} (1^{o} West of North).

If one is using a magnetic compass rather than a gyro compass, then bearings are usually indicated by readings such as N 30^{o} E, S 50^{o} E, S 15^{o} W, N 60^{o} W. (See Diag.1)

This diagram is called a "compass rose"

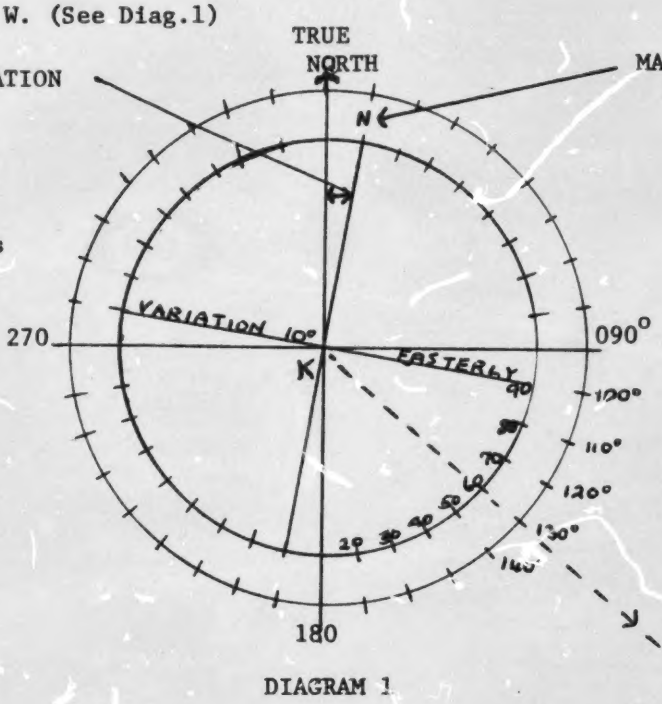


DIAGRAM 1

To obtain a true bearing from a magnetic compass one must make a correction in accordance with the "variation", which is the difference between magnetic north and tru north. The amount of variation and the direction of variation east or west of true north depend upon the observer's position on the face of the earth but the compass rose usually indicates what the variation is in that particular region. (See diagram #1) It might be advisable to limit the work of pupils to the True directions.

DIAGRAM 2

It is obvious that, if an observer at A says that "B bears 090°" then an observer at B would say, "A bears 270°", 090° and 270° are called reciprocal bearings. Pupils must be careful to read the bearing from the observer to the point of which he is "taking a bearing." (See Diag. #2)

The following will indicate the procedure that would be followed on the bridge of a ship.

(a) The officer on duty tells his assistant to "Take a bearing of the Trowbridge Island light."

(b) The assistant sights across the top of the ship's compass through a pair of sights like those on a rifle and reads the direction or bearing of the light from the ship.

(c) The assistant tells the officer what the bearing is by saying, "Trowbridge Island light bears 145°".

(d) The officer lays his parallel rulers across the compass rose on the chart so that one edge of the ruler cuts through the center of the rose and through the point on the circumference which marks 145°.

(e) The rulers are then moved step-by-step across the chart until the edge passes through the point on the chart which marks the position of Trowbridge Island Light.

(f) If a line is then drawn along the ruler's edge, the officer knows that his ship is somewhere on that line.

To know that one's ship is "somewhere on that line" is rather unsatisfactory as that line may well traverse dangerous rocks and shoals. Therefore it is necessary to take bearings of two or more landmarks (lighthouses, buoys, points of land, etc.) in order to "fix" the ship's position at the point where the lines of bearing intersect. (See Diagram #3)

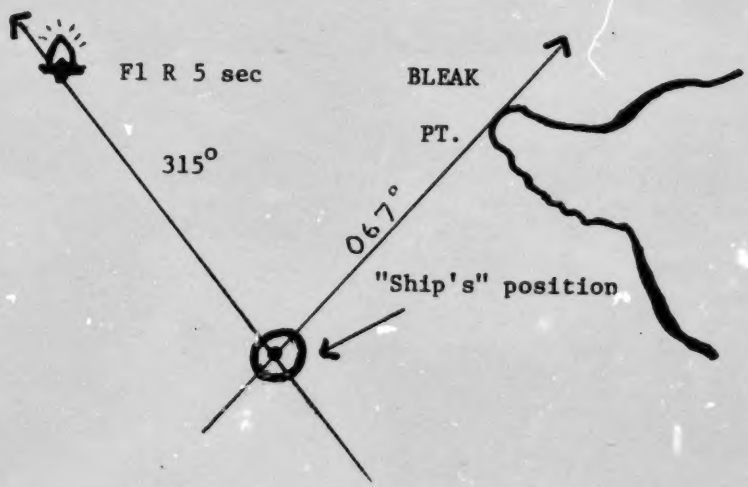


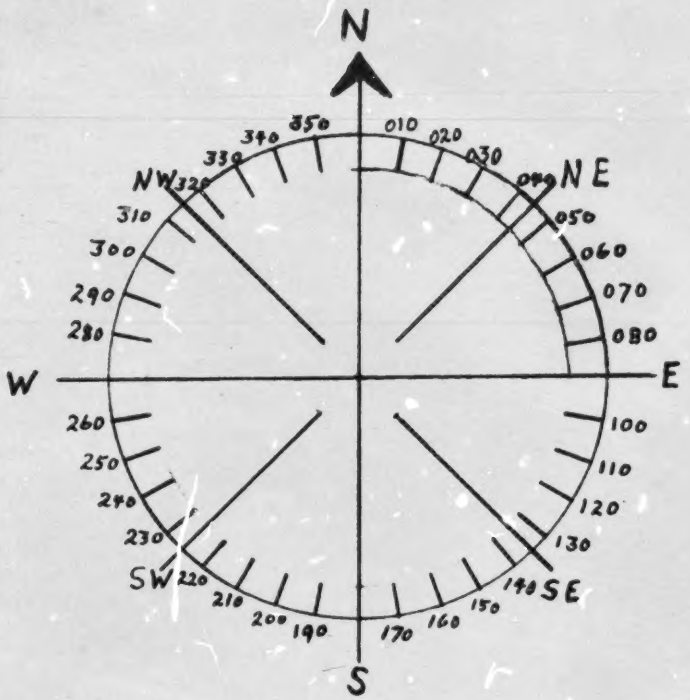
DIAGRAM 3

Activity #1 PRACTICE WITH PARALLEL RULERS *

Prince Edward is your ship lying in an anchorage. Eight other ships are also at anchor. The duty officer on your ship "takes a bearing" of each of the other ships and records these bearings in his deck-log. Complete the deck-log entries for each ship (as shown here for the *Acton* and *Brixton).*

Acton bearing	315°
Brixton bearing	020°
Cliffhall bearing	____
Dart bearing	____
Exeter bearing	____
Forester bearing	____
Granada bearing	____
Hydra bearing	____

* Students will need to use the chart on the following page in order to complete this activity.



ACTIVITY # 1

× Brixton

× Acton

× Cliffhall

× Dart

× Hydra

Prince Edward

× Granada

× Forester

† Exeter

(This chart should be used for a transparency and for reproduction for students' use.)

Activity #2 USING DIVIDERS & LATITUDE SCALE TO MEASURE DISTANCE

Objectives:

Upon completion of this exercise the student will be able to:

1. measure with 95% accuracy the distance in nautical miles between two locations on a chart using dividers and the latitude scale along the sides of the chart.
2. express in degrees and minutes the latitude and longitude of given points on a nautical chart accurate to the nearest minute.
3. explain each of the following terms:

   anchorage, nautical mile, minute of latitude, knot.
4. express as a true bearing within 2° of accuracy the direction from one point to another on a ship's course using parallel rulers and the compass rose.

DISTANCE & SPEED ON A NAUTICAL CHART

Pupils should be made aware that one degree of latitude is equal to 60 nautical miles and that one minute of latitude is, therefore, equal to one nautical mile. (approximately 2,000 yards)

Since the mariner measures the speed of his ship in nautical miles per hour, it is convenient to use the latitude scale at the sides of the chart for the measurement of distance.

(Note: The expression "knots per hour" is incorrect as a unit of speed because the word "knots" means "nautical miles per hour". We therefore say that "a ship's speed is 10 knots.")

To find the distance between "A" and "B" on a chart, place one point of a pair of dividers on "A" and the other point on "B". Transfer the dividers to the latitude scale at either side of the chart and read the number of minutes separating the points. This will be the number of miles between "A" and "B".

If "A" and "B" are too far apart to be spanned by the dividers, then with the dividers set at a convenient distance (say 3 or 5 miles) mark off this distance as often as possible along the line joining "A" and "B", then measure the remaining segment of "AB" and by addition find the total distance from "A" to "B".

(Note: Pupils must not use the scale of longitude at the top or bottom of the chart to measure distance for only at the equator will one minute of longitude be equivalent to one nautical mile.)

Activity #2 DIRECTION AND DISTANCE ON NAUTICAL CHARTS *

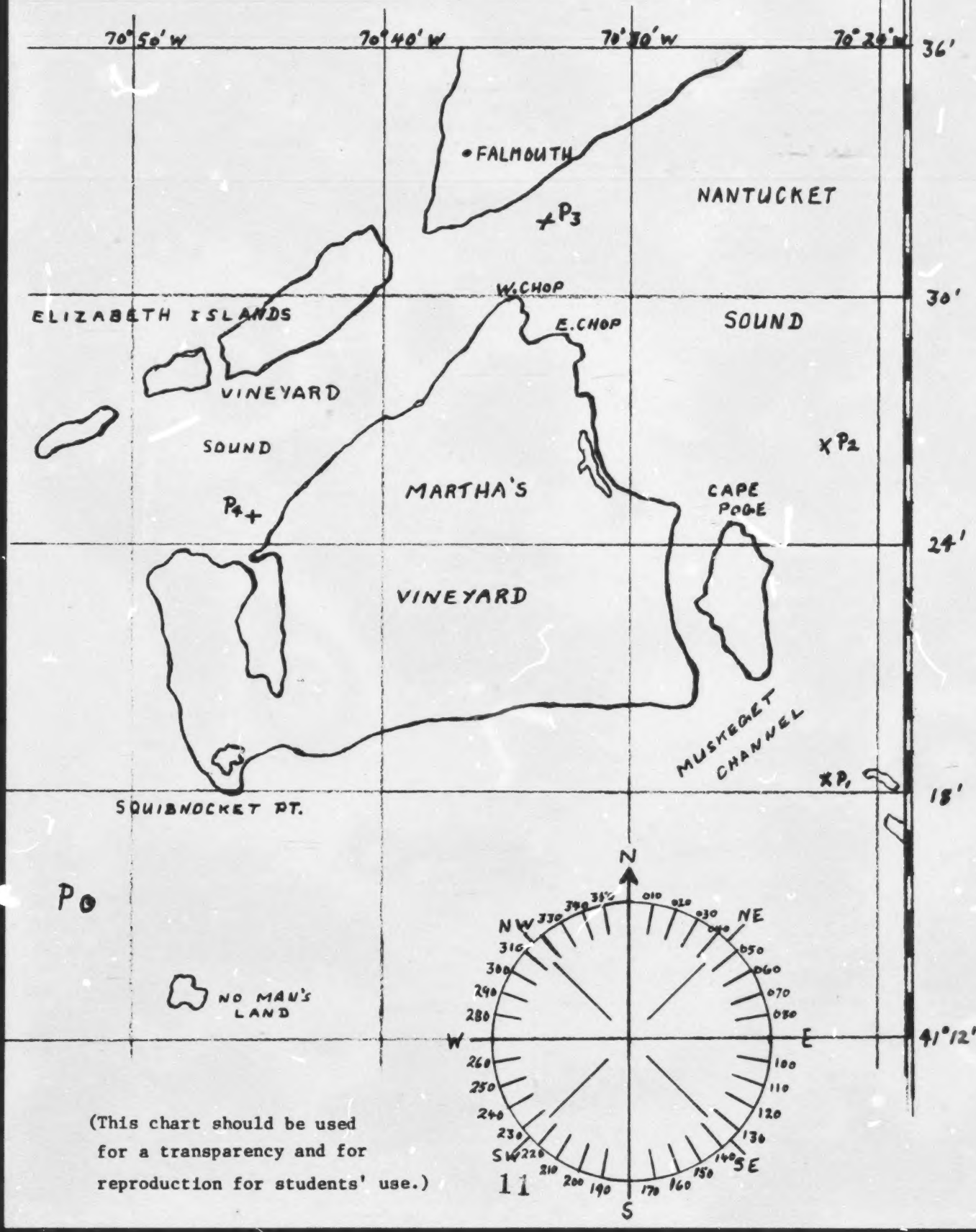
Lay out courses to steer and distances to run to bring your ship from her present position "P" to an anchorage at "P_4", passing through "P_1", "P_2", and "P_3".

(Disregard tidal stream and currents).

	True course	Distance
P to P_1	_____	_____
P_1 to P_2	_____	_____
P_2 to P_3	_____	_____
P_3 to P_4	_____	_____
TOTAL DISTANCE =		_____

* Students will need to use the chart on the following page in order to complete this activity.

ACTIVITY #2



(This chart should be used for a transparency and for reproduction for students' use.)

ACTIVITY #3

Objectives

Upon completion of this activity the student will be able to:

identify with 100% accuracy on a nautical chart the symbols given in the legend below.

SYMBOLS COMMONLY FOUND ON NAUTICAL CHARTS

Symbols Showing Depths of Water:

1 fathom line

2 fathom line

3 fathom line

10 fathom line

(* On harbour charts the soundings are shown in feet rather than fathoms.)

Symbols Showing Subsurface Characteristics:

shoal with a rock below the surface

\+ rock (sometimes the height of the rock above water is recorded)

r rock)
cl or cy. clay) All of those describe the type of bottom
s or S sand)
g or G gravel)
m or M mud)

Symbols Showing the Characteristics of Lights:

R - red)
W - white)
G - green) Combinations of these will indicate the nature of the light observed
Fl.- flashing)
F - fixed)
Int.- interrupted)
U - unwatched or unmanned light)
20 sec.- flashing intervals)

Other Significant Symbols:

can buoy

conical buoy

spar buoy

common shipping tracks

rock

anchorage

Activity #3 CHART SYMBOLS *

1. What is the greatest depth of water that a vessel will encounter on the "track usually followed" from Middlebrun Channel to the NE corner of Edward Island?

2. How deep is the water over Copp Rock which lies ½ mi. West of Cranberry Is.?

3. If your ship has a draft of 12 feet, would you consider sailing between Porphyry Is. and Edward Is.? Give a reason for your answer.

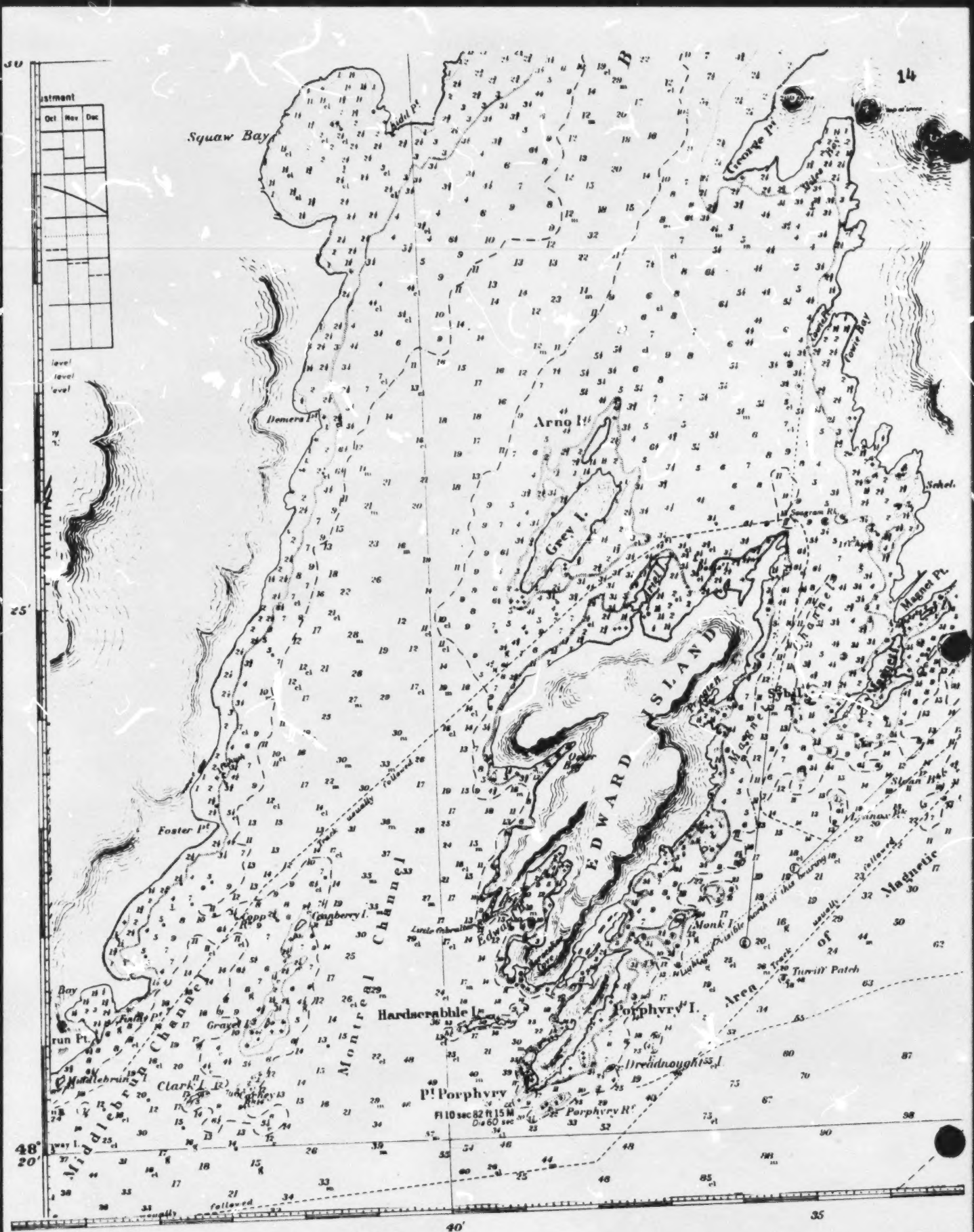
4. Why is the bay West of Copp Rock marked as an anchorage while Squaw Bay is not so marked?

5. Compare the underwater slope along the West side of Edward Is. with the underwater slope off Kidd Pt.

6. At what distance would Point Porphyry Light be visible on a clear night? What is the characteristic of that light?

7. Locate three places where rocks, reefs or shoals would make navigation hazardous.
   Identify one location where the rock shows above water.

* Students will need to use the chart on the following page in order to complete this activity.


Squaw Bay
Arno I.
Grey I.
EDWARD ISLAND
Foster Pt.
Hardscrabble I.
Porphyry I.
Pt Porphyry
Fl 10 sec 82 ft 15 M
Dia 60 sec
Porphyry Rk
Monk I.
Dreadnought I.
Turrill Patch
Clark I.
Middle Channel
Monroe Channel
Area of Magnetic
Magnet Pt.
Sybil
Foster Bay
Demera Pt.
Gravel I.
Edwards Rk
Little Edwards
Middlebrun Pt.
Bay
14
15
48°
20'
45'
40'
35'
25'

Activity #4 CHARTWORK

Objectives:

Upon the completion of this simulation exercise the student will be able to:

1. use parallel rulers and the compass rose on a nautical chart to lay out a course between two points on the chart with a measurement error of less than three degrees.
2. use parallel rulers and the compass rose to state within 2^{o} of accuracy the true bearing between two points on a nautical chart.
3. use dividers and the latitude scale to measure the distance between two points on a nautical chart with 95% accuracy.
4. use the terms nautical mile, minute of latitude, bearing, anchorage, knot, compass rose, starboard, port correctly when plotting a course on a nautical chart.
5. identify the following symbols on a nautical chart in order to make a logical decision as to the selection of a safe anchorage for a ship:

cl, s, m, g, ..., ..., t, _._._.,

CHARTWORK - PASSAGE ISLAND TO THUNDER BAY *

I Your ship, on the regular shipping track, is bound for Thunder Bay from Sault Ste. Marie. When Passage I light bears 031°, ½ mi. to starboard, you alter course to 310°.

(a) What will be the bearing of Passage I light and Blake Point light when you must alter course to 277°. .....

(b) What is the distance in nautical miles to Pt. Porphyry light when it bears 007° ? .....

II A severe SE gale causes you to decide to run for shelter in Sawyer Bay (48°22'N, 88°52'W.)

Lay off a course to reach Sawyer Bay as follows:

(a) When Thunder Cape light bears 020°, alter course to 355°.

(b) When the south edge of the entrance to Sawyer Bay bears 074°, alter course to 070°

(c) What kind of bottom is there in the anchorage? .....

Indicate with an X on the chart where you would anchor your ship. Explain why you chose this particular location in the bay.

III (a) When the gale abates, what course would you steer to reach the North entrance of Thunder Bay harbour? .....

* In order to complete this activity students will need to use the chart Passage Island to Thunder Bay which is available from the Canadian Hydrographic Survey. If the teacher wishes, another chart can be substituted and a similar worksheet can be formulated.

III cont'd. (b) How far (in nautical miles) is it from Sawyer Bay to the North entrance? .....

(c) If your speed is 6½ knots, when will you reach the North entrance if you leave Sawyer Bay at 6:00 a.m.? .....

GLOSSARY

Anchorage	- a place protected from winds or storms where ships may lie at anchor in safety.
Bearing	- a direction from one point to another indicated by a compass reading.
Fathom	- a measure of 6 feet in depth
Fathom lines	- a series of dots or dots and short lines on a chart connecting points of common depth.
Fixed light	- a light that shines without flashing.
Interrupted Light	- a light that is visible only within a particular sector of the circle.
Knot	- a measure of speed equal to one nautical mile per hour.
Nautical Mile	- a distance equal to one degree of latitude (approximately 2000 yards.
Port	- the left side when facing forward in a ship - (indicated by a red light)
Shoal	- a ridge of rock or sand below or close to the surface of the water.
Soundings	- recorded depths of water, usually in fathoms but often in feet on harbour charts
Starboard	- the right side when facing forward in a ship (indicated by a green light).
Variation	- the angular difference between magnetic north and true north.

SOME SUGGESTIONS FROM THE AUTHORS

1. The use of parallel rulers and dividers in laying off bearings and in measuring distance can be effectively demonstrated by the teacher utilizing transparencies of regions of charts and the appropriate instrument. Students could carry out the activity on their own copies of the same chart region.

2. When using the actual charts all work should be done lightly in pencil so that the markings may be erased.

3. The activities may be individualized by providing work-cards for students with accompanying self-correcting materials such as answer-cards and acetate overlays.

4. Have students draw cross-section diagrams of the bottom of a channel or bay as a means of illustrating the significance of fathom lines.

5. Charts of the Great Lakes may be obtained from the following sources, or from bookstores in port cities:

Canadian charts: (approx.$1 - 1.50)	Canadian Hydrographic Service Marine Sciences Branch Dept. of Energy Mines & Resources, 615 Booth Street, Ottawa, Ont.
U.S. charts: (approx.$1.75 each)	Dept. of Commerce, National Ocean Survey, Lake Survey Centre 630 Federal Building, U.S. Courthouse Detroit, Michigan 48226

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